Developments in reflective X-ray optics for the ESRF Upgrade Programme

R.Barrett

X-ray Optics Group, ESRF, CS 40220, 38043 Grenoble Cedex 9, France.

Author Email: barrett@esrf.fr

An important element of Phase I of the ESRF Upgrade Programme, has been the renewal of the X-ray instrument portfolio with 19 new or refurbished beamlines. This programme has driven the development of a considerable number of new reflective optical systems. Within this upgrade programme over 35 mirror and multilayer optics systems for the new beamlines have been designed, assembled and installed by the ESRF. These devices range from high heat-load mirror systems to multilayer-based nanofocusing mirror systems and also include multilayer-based monochromators. The use of generic design principles has enabled the delivery of tailored systems to the beamlines based upon well proven solutions. In particular for the micro- and nano-focusing mirror systems this approach has permitted an optimized integration of the opto-mechanics within the end-station design allowing the use of compact and inherently stable focusing.

Critical for the success of this strategy has been the availability of in-house expertise in a variety of domains, spanning mechanical design and modelling, cooling technologies, thin-film coating methods and advanced motion and surface metrology methods. For the latter it is particularly important for the ex-situ validation of the system that, wherever possible, characterization of the optical surface can be performed not only in the unconstrained state but also in the final opto-mechanical mount.

This talk will present a selection of the reflective optics which have been implemented at these new ESRF beamlines with particular emphasis upon i) high-heat load mirror systems and ii) dynamically and statically figured mirror systems for micro- and nano-focusing. These illustrated examples will also serve to demonstrate the current level of ESRF expertise in the various key technological fields indicated above.

Phase II of the ESRF Upgrade Programme, which began in 2015, heralds the beginning of the project which will involve the replacement of the current ESRF storage ring within the existing accelerator tunnel by a new ultra-low-emittance 6 GeV hybrid multibend achromat (MBA) lattice [1]. This will offer hard X-ray synchrotron beams of unprecedented brightness and coherence. Some of the challenges and opportunities that will be offered by the new beam characteristics for X-ray optical systems will be addressed.

References

[1] J. Susini *et al*., "New Challenges in Beamline Instrumentation for the ESRF Upgrade Programme Phase II." J. Synch. Rad. **21**, [5] (2014): 986–95. doi:10.1107/S1600577514015951